

Malayan Trombiculid Mites

2. Naked-eye observations on attached chiggers, with a simple checklist of Malayan species, and details of preferred hosts

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THE OBJECT of this paper is to summarize the naked-eye appearance, favourite hosts, and favourite sites of attachment of the 83 species of trombiculid mites so far collected in Malaya by the Colonial Office Research Unit. These observations were incidentally made during the course of a general survey of animals and their parasites² as potential reservoirs and vectors of infections involving man. The collections, mostly from Selangor, have been described elsewhere (Audy & Harrison, 1954). Since 1948, over 21,000 animals have been searched and their ectoparasites mounted or preserved, mostly by M. Nadchatram and Lee Fatt-Hing, but also by Johann bin Haji Adam and Phang Ong-Wah. The routine identification of the trombiculids has been the responsibility of Nadchatram. Other collections have been made, mostly in Borneo, jointly by U.S. Army workers (led by Robert Traub) and members of this Unit (see Traub & Audy, 1954) but these are not considered here.

The opportunity is here taken of listing all the species so far found in Malaya, confirmed new species being shown by the first three letters of their manuscript names or a reference number. Some seven additional forms, probably new species but requiring further study, are excluded. The basis for the taxonomic arrangement is that of the checklist in Wharton & Fuller (1952), with slight modifications as discussed by Audy (1954, 1955abc) plus the introduction of the genera *Babiangia* and *Schoutedenichia* and the subgenera *Helenicula* and *Laurentella*, since described.

The characters discussed here are those which can be seen by the naked eye of an observer familiar with chiggers, aided occasionally by a hand-lens ($\times 10$ to $\times 25$).

Naked-eye appearances

General appearance.—The parasitic trombiculid larvae or chiggers range in size from minute specks (0.15 mm.) to fairly large swollen bodies of 1.5 mm., varying greatly according to species and the degree of engorgement. They attach to their hosts in various favoured sites, discussed below, scattered about singly or in small groups, or in closely-packed colonies, or sometimes both scattered and in colonies, according to species of chigger, species of host, and intensity of infestation. They are numerous, some animals regularly supporting an average of nearly 100 per individual, while there may be many thousands attached to even a small animal. Larvae of some groups are generally very small, such as most Gahrliepiines and the subgenera *Walchiella*, *Trombicula* sens. str. and *Laurentella*; others are large, such as the *Euschongastia lacunosa* group, *Blankaartia*, and *Whartonias*. Certain chiggers appear to become grossly engorged, being

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almost helpless when detached, and becoming distorted when mounted, often with the scutum folded or inverted at the anterior fold of the body which overlaps the mouth-parts; such chiggers are *Euschöngastia lipoxena*, the intranasal species of *Doloisia*, and *Trombicula vorca* (the last being found in Borneo, not Malaya). Certain species or groups show a transverse constriction or "waist" when engorged—e.g. many *Gahrliepia* (especially *Walchia*), *Doloisia*, *Laurentella*, and *T. (T.)'NOR'*. Otherwise, most species are ovoid, though a few are subglobular such as *T. hastata*, *T. consueta*, *T. keukenschrijveri*, *E. lipoxena* and some *Walchiella*. A few species are found to present a peculiar desiccated or shrivelled appearance, flattened and translucent, when attached to certain less-favoured sites: this has been repeatedly observed with *Gahrliepia fletcheri* and *T. keukenschrijveri* when attached to the edges or the outside of the host's ears. Within the ear and also elsewhere on the body even on the same host, the mites appear normal, while those outside the ears appear dead and are most difficult to detach. The larvae of *T. dimolitae* from the ear of a bat appeared so shrivelled and dead. The surfaces of the engorged larvae of some species may show such recognizable characters under the hand-lens as:—

- (a) large dense scuta in the *G. ornata* group;
- (b) a peculiar dimpling presumably due to the depression of sites of muscular attachment or retraction of suspended organs within, as is so commonly seen in the post-larval stages, although the dimpling is more punctate in the nymphs and more shallow in the larvae; such dimpling is best seen in the detached engorged larvae, and is for example easily visible in *Siseca subrara* (but not in *S. rara*), intranasal *Laurentella* ("TAA" and "TBB" but not "LAU"), and it particularly contrasts with other species (*Blank. acuscutellaris*, *E. (W.) oudemansi*) whose cuticle always appears to be tensely inflated;
- (c) the cuticular striae, occasionally well-developed as in all *Walchiella*;
- (d) the body setae, which show up particularly well by suitable lighting and probably give the most dependable information; these setae may be prominent because of unusual numbers (cf. the series *T. deliensis*, *T. akamushi*, *T. keukenschrijveri* with DS counts of 28, 36, 50), or unusual development such as length (*E. "THOM"*; *T. pipellae* from Borneo), plumosity (*T. keukenschrijveri*), or other modification (e.g. the more bizarre *Trombiculindus* species of India).

Colour.—The colour of chiggers ranges from a translucent near-white or off-white to bright scarlet. In the tabulation which follows, near-white larvae are described as *pallid*. The colour usually pales with increasing engorgement. Taken as a whole, the Malayan species are pallid, yellow or pink tinted, or orange to red coloured, in roughly equal proportions, but when the commoner species are considered, pallid species are relatively few, most being yellowish or pink to light orange, while a few are relatively strongly coloured. The same species may vary considerably in colour (e.g. *E. (W.) oudemansi*, *E. (L.) indica?*, see below) but we have in several cases found colour differences to assist in the detection of distinct but similar species, e.g. *T. deliensis* (coloured) and *T. "LAN"* (pallid), *E. (L.) indica* (pallid) and *E. (L.) audyi* (coloured), *Siseca rara* (coloured) and *S. subrara* (pale). An orange-coloured form of *E. indica* found in the forest is currently being investigated for possible morphological differences (Audy 1956a).

Attachment to Hosts

The manner of attachment and feeding of chiggers on their hosts, with the formation of a stylostome or sucking-tube, has been described in detail by Jones (1950) and others. So also have local reactions to their bite (scrub-itch, trombiculiasis), particularly by Parkhurst (1937), Nuñez (1947), and Siqueira (1949). The length of time for which they feed in situ has been studied particularly by Harrison (1954). All these features, together with the favoured sites of attachment on the host, have been summarized and discussed by Wharton & Fuller (1952:115). The following observations summarize findings in Malaya, with some references to conditions in India (Audy *et al.*, 1953).

The attachment of chiggers gregariously in closely-packed colonies or individually scattered is related partly to the habits of the species in relation to the particular host's skin, and partly to degree of infestation. With the heavier infestations, colonies may be formed in favoured places while the "overflow" may attach singly or in small groups elsewhere.

Reptiles.—The generally favoured sites of attachment on reptiles are in the axillae and wholly or partly under scales on the flanks and belly, around the throat, on the inner and outer sides of the thighs, and around the anus and base of the tail; occasionally, on the toes. Loveridge (1925) found clusters of chiggers (*Acomatacarus?* *gymnodactylus* (Ewing)) in deep soft-skinned axillary pockets of geckoes from India. These "mite-pockets", to which Loveridge gave the picturesque name of acarodomatia, were frequently found in African lizards and geckoes by Lawrence (1949:479), but they are not conspicuous in Malayan species in which the axillae are simple folds. The Varanids (monitor lizards) have axillary folds which can be described as pockets, but these appear to be favoured by ticks and not by chiggers, although *Eutrombicula wichmanni* has been found infesting the haunches. Chiggers on reptiles in Malaya are frequently found underneath the scales, producing tenting, though Southcott (1954) states that this is unusual in Australia; and while he has described (1947) chiggers as being usually present in the auditory canals of lizards, we have never found this site favoured in Malaya. It is obvious that a comparative study would be very interesting. The wing-expansions of flying-lizards in Malaya have yielded interesting species.

Birds.—In common with Lawrence's findings in South Africa we have found birds to be rarely infested by chiggers in Malaya (Audy, 1956b: 72, 78), the only exception being quail and rails, heavily infested by the vectors of scrub typhus, and domestic fowls infested by *E. (Eutrombicula) wichmanni* and *Neoschöngastia gallinarum*, mostly in mixed colonies in ulcers under the wings and among the feathers, especially in the flanks. In North Borneo, joint expeditions with the U.S. Army Unit have also found certain birds in certain localities to be freely infested, e.g. crow-pheasants with *T. wichmanni* and *T. vorca* (Traub & Audy, 1954:47).

Mammals.—The generally favoured site of attachment of chiggers to mammals is to the thin inner epithelium of the ear especially of rodents. The deeper part (concha) is divided into two fossae by a fold: the inner fossa is the most favoured site, and as this fills up, the adjacent outer fossa is selected. Closely packed colonies may easily be seen in these fossae. While chiggers may attach almost anywhere else on the body, specially favoured sites, presumably where the epithelium is thin and protected, are elsewhere on the pinnae of the ears, around the lips or muzzle, the folds (inguinal or axillary) of hind or fore legs, and around teats, genitalia, and anus. In addition certain chiggers favour

protected and permanently moist sites, such as *Ascoshöngastia malayensis* deep in the bony auditory canal of *Rattus canus*, *Euschöngastia oculicola* (Wom.) in the conjunctivae of rats in Ceylon, and various species, especially *Euschöngastia* and *Doloisia* (and in Africa, Gahrlipiines), deep in the intranasal cavities of rodents (Fig. 2), a habitat which is still being explored (Audy & Vercammen-Grandjean, 1955).

Some groups show special preferences for sites other than the inner conchae of the ears. The Gahrlipiines often favour the edges of the ears, the chin and lips (fig. 1), and occasionally the muzzle (vibrissae), inner thighs, and anal region. Intranasal species in Malaya are mostly confined to *Doloisia* (VN-group) and subgenus *Laurentella*, though Traub has recorded a *Leptotrombidium* from this habitat in Borneo (I.M.R., 1955). Traub & Morrow (1955:45) have described a hypodermal species, *Gahrliepia (G.) penetrans*, which had burrowed completely into the perineal skin of *Rattus whiteheadi* in Borneo.

The same species frequently prefers different sites on different hosts, apart from the obvious differences between mammals and reptiles or birds, two or all three of which are frequently included in the host-range of *E. (Eutr.) wachmanni*, *S. rara*, *T. (L.) akamushi*, and *T. (L.) deliensis*. For example, the vector *T. deliensis* prefers the ear-fossae of rats or voles over the whole range of its distribution, but in Malaya it may also infest, for example, (a) the shrew-like erinaceid *Hylomys*, in colonies on the hairless rump, a relatively hairless patch on the belly, in the usual thin-skinned parts of the body (axillary and inguinal folds, inner thighs) and generally scattered about, but not all down the midline of the venter; (b) the larger tree-shrew *Tupaia glis*, in colonies in axillary and inguinal folds and along the midline of the venter; (c) shrews, *Crocidura*,

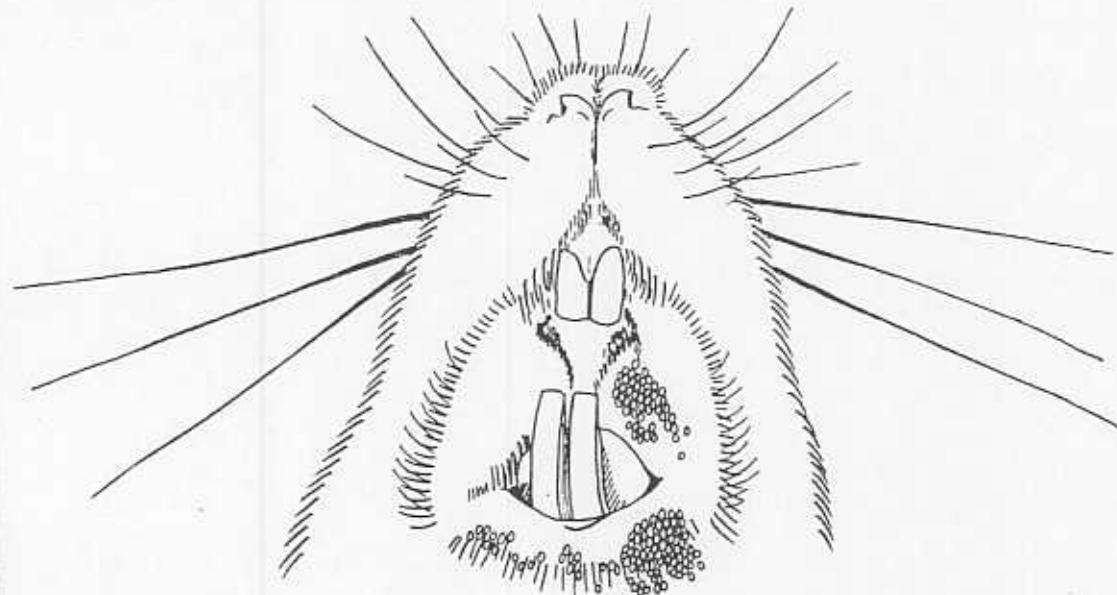


Fig. 1. Muzzle of *Rattus rattus jarak*, Jarak Island, 1949, with colonies of *Gahrliepia (Walchia) rustica* (Gater) on chin and cheek-pads. *Trombicula deliensis* was present in large numbers in the ears. The same distribution was found with *Gahrliepia (G.) fletcheri* (Gater) on rats in the Sembilan Islands, and *G. (W.) rustica* from rats on Berhala Island. These gahrlipiine chiggers are usually found on the ears of rats on the mainland.

in colonies on the rump, axillary and inguinal folds, hind legs, and also generally scattered. In Manipur, India, this chigger was very common on the belly and rump of *Tupaia glis belangeri*; and also on the belly, inguinal folds, inner thighs, genitals and anus of the common shrews, *Suncus murinus*, which we have rarely found to be infested in Malaya. Also in Manipur, thousands of chiggers of this species were found attached to macaque monkeys down the midline of the body and in orange-coloured rows along the eyebrows and edges of eyelids. In Malaya, rails and quail are often heavily infested on the breast, belly, and under the wings, but especially in a small area on the sternum in the midline. Similarly *Gahrliepia fletcheri* is usually found within and along the edges of the ears of forest ground-rats and ground-squirrels, but on *Rattus rattus rumbia* on the Sembilan Islands it covered the chin as in fig. 1, as well as at the bases of the vibrissae; on *Tupaia glis* it prefers the venter and ears.

Tenacity of attachment.—Unfed or slightly engorged larvae are generally more difficult to detach artificially than engorged larvae, and larvae in colonies appear to be more readily detached than single ones or larvae in small groups. The tenacity of the same species may differ on different parts of the same host, probably being harder to detach from tougher skin; *T. keukenschrijveri* is noticeably harder to detach from the body

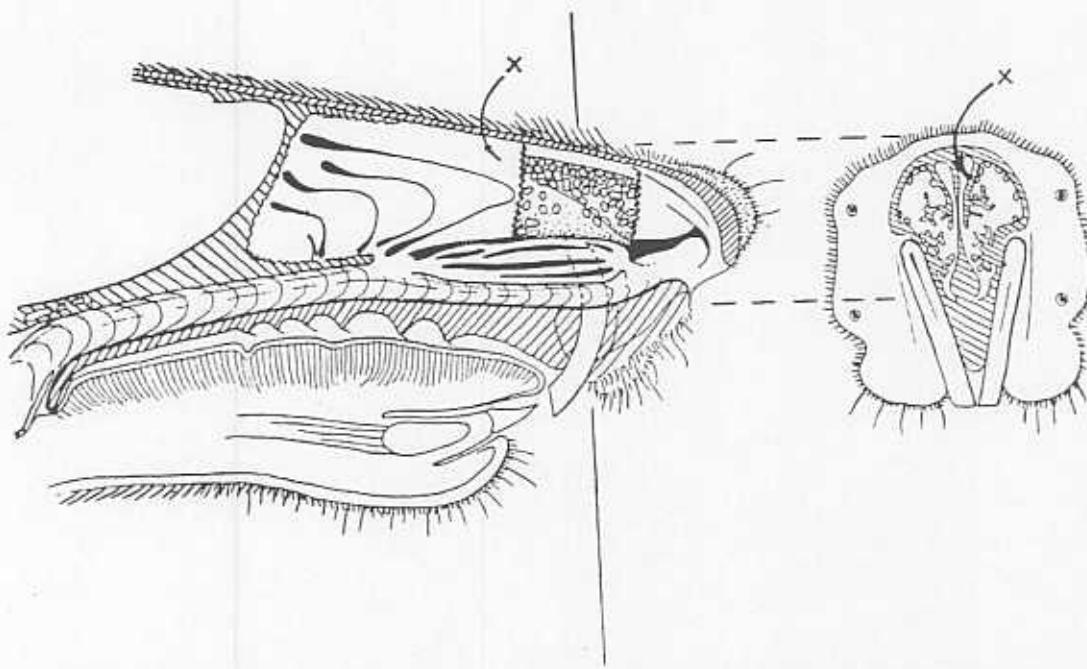


Fig. 2. Site of election for intranasal chiggers in *Rattus rajah* from forest in Selangor (semidiagrammatic). The septum has been removed and the left naso-turbinal (X) partly resected. Most of these chiggers would represent the *Doloisia VN*-group (an average of 30 chiggers per rat, usually 2 or 3 species) and a few would be *Euschöngastia (Laurentella) TAA* and *TBB*. The naso-turbinals are much more developed than the maxillo-turbinals below them, and the site of election for intranasal chiggers in Malaysia appears to be the walls of the chamber lateral to the naso-turbinals, especially against the part of the nasal bone exposed in the diagram. This chamber may occasionally be choked by a hundred or more chiggers.

than it is from the ears. Possibly for similar reasons, the same species may vary on different hosts; *Eutr. wichmanni* is generally much more easily detached from domestic fowls than it is from rats.

Some species attach fairly lightly and may be readily detached without damage by means of a mounted bristle or needle; such species are most *Gahrlipiines*, *T. deliensis*, *Eusch. indica* and *E. oudemani*. The intranasal species hardly appear to be attached to the nasal mucosa but it may be that they detach almost immediately on killing the host, though they do not emerge from the nose in significant numbers. *Ascoschöngastia malayensis* and *E. (L.) "CAN"* similarly lie about in the mucus of the auditory canal. Some species are attached so firmly that it is almost impossible to detach them without damage, in which case fragments of infested skin must be snipped off. Such are many species of bat-chiggers (e.g. *Whartonina* and subgenus *Trombicula*), and *Blankaartia acuscutellaris*. Most reptile-chiggers found in Malaya have been lightly attached (possibly because they are usually protected by the scales), but *Neoschöngastia riversi* was firmly attached to the wings of a flying-lizard. Associated with firm attachment there is often a tendency to bury the mouthparts or even the whole forepart of the larvae in the skin, some of the burying perhaps being due to reaction on the part of the host. *Whartonina* on the wings of bats is an example. It is doubtless this same tendency which leads through partial burying to the completely hypodermal habitat observed in the genus *Hannemania* (hypodermal in amphibia), some *Gahrlipiines* in Africa (e.g. new genus, Vercammen-Grandjean, in press) and the hypodermal *Gahrliepia (G.) penetrans* found by Traub in pits in the vulva of a rat in Borneo. Hypodermal chiggers have not so far been found in our Malayan collections.

Favourite hosts and host-specificity

Wharton (1946), Lawrence (1949), Wharton & Fuller (1952) and other observers have noted that the trombiculids generally show little or no host-specificity, but rather a varying degree of habitat-specificity. Our observations in Malaya have borne this out. Habitat-specificity may give an appearance of host-specificity, and occasionally it may not be possible to explain findings confidently by one explanation or the other. For example, it would now appear that the genera *Blankaartia* and *Heaslipia* pertain particularly to water-birds or swamp-loving birds such as crow-pheasants, but in our collections in Malaya, based largely on mammals, these genera are each represented by one species which has been found only on *Rattus r. argentiventer* frequenting certain rice-growing areas where the fields are regularly flooded. It is therefore important to separate casual from principal hosts, and to refrain from drawing conclusions without extensive as well as intensive collection.

It is however now clear that (a) certain groups pertain particularly to reptiles (e.g. *Eutrombicula* sensu lato, including *Eltonella* Audy, and *Babiangia*; Audy, 1956b), or even to snakes only (*Fonsecia*), others to birds (*Neoschöngastia*), and others almost exclusively to mammals (subgenera *Leptotrombidium*, *Neotrombicula*, and *Trombicula*); and (b) certain groups specially closely related to their hosts in one way or another, show signs of developing true host-specificity in some of their members (e.g. *Ascoschöngastia* and *Laurentella*, see Audy, 1956a).

The following table shows the pattern of distribution on various hosts of those trombiculids in Malaya which occur in significant numbers. For the purposes of this paper, it is intended to guide the collector to the host of choice for the recovery of various species of chigger, and to serve as a provisional checklist.

A list of Malayan Trombiculid Mites with available data on naked-eye or hand-lens observations

Taxonomic arrangement as described on page 86. (N, A) signifies that Nymphs, Adults have been reared.

Characters: measurements in microns; unless otherwise stated, for partially engorged larvae. UL, PEL, EL = unfed, partially engorged, and engorged larvae, respectively.
 Habitat etc: Only major hosts are noted here. Figures in parenthesis are the average number of chiggers per host for those species which occur at a rate of 1 or more per host.

Subfamily TROMBICULINAE

Trombicula Berlese, subgenus *Trombicula*, *sensu stricto* after Audy 1954

1. *batui* Philip & Traub, 1950 Small, 330×190 , elongate; pallid. Peropodid (*Eonycteria*) and Emballonurid (*Taphozous*) bats; local; occasional. Firmly attached undersurface wings.
2. *dimolitae* Audy, 1952 400×290 , subovate, appeared shrivelled; yellowish. Rhinolophid bat, firmly attached to inner side of edge of one ear. (Probably also to be found on wing membranes).
3. *harrisoni* Womersley, 1952 (N) Very small, 300×200 , broad, oval; pink. Rhinolophid bats (*Hipposideros*, 1-2), commonest bat-chigger, scattered, firmly attached close to leading edge on outer face and along middle digit on inner face of wing, mixed with *Eiarcha lipoxena*. Peropodid (*Eonycteria*) and Emballonurid (*Taphozous*) bats; firmly attached, mixed with other spp., on wings.
4. *insolii* Philip & Traub, 1950 Small, 330×290 , elongate; pallid. House-rats (*R.r. diardii*), and wood rat (*R.r. jalorensis*) in small numbers mixed with *E. indica* in ears.
5. *munda* Gater, 1932 (N) $300-410 \times 210-290$, elongate; pallid to light orange. Tombo-bats (*Taphozous*) from forest; about 300 chiggers on 7 out of 7 bats; on outside of ears easily overlooked unless the membranous ears are stretched; not firmly attached.
6. "NOR" (NA) 350×200 , subovate, slight transverse constriction; light orange to orange. Arboreal animals (*Callosciurus notatus*, 3; *Tupaia glis*, 2; *Rattus canis*, 1), small numbers, scattered, with *Laurentella* spp.
7. *spicata* Gater, 1932 (N) $290-330 \times 200-230$, subovate; light yellow to orange. cf. *T. dimolitae* Rhinolophid bat (*Hipposideros*); 3 specimens on wing-membrane.
8. "PAR"—CORU, 25066

Trombicula, subgenus *Leptotrombiculidium* Nagayo *et al.*, *sensu lato* after Audy, 19549. *akamushi* Brumpt, 1910 (NA)UL 220 × 150, PEL 510 × 350, ELS 560 × 400, elongate subovate to subglobular, smooth, more hairy than *T. deliensis*; orange to dark orange; active, detach quickly, climb to ends of hairs, wander on bench freely.10. *deliensis* Walch, 1922 (NA)Same as *T. akamushi* in all features except that the colour is generally less dark orange and that the slightly lesser hairiness is detectable with a hand-lens. 410-390, smaller than *T. deliensis*, subglobular; pale orange to orange; many dorsal setae readily detectable with hand-lens—a point of difference from *T. akamushi*.11. *keukenshuijveri* Walch, 1923 (N)cf. *T. deliensis*, PEL 540 × 460; broad subovate, almost subglobular; pallid to yellowish; DS more conspicuous than those of *T. deliensis*, stronger and more plumose; not active, do not detach easily.

12. "LAN"

480 × 340, similar to *deliensis*; pallid. 480 × 340, similar to *deliensis*; pallid.13. *muridia* Womersley, 1952 (N)Large, EL 1,000 × 600, elongate oval, posterior and broad; pallid; coarse striation of body may be visible with hand-lens; clumsy and sluggish, tends to cling; not easily separable from *Eusch. lacunosa* but easily distinguished from other species.14. *sylovestris* Audy & Traub, 1950 (N)

450 × 260-350, subglobular; pallid to light yellow.

15. *hastata* Gater, 1932 (N)Spiny-rat (*R. rajah*) in forest; occasional, scattered, in ears among other chiggers, ?local (Ulu Langat, F.R.) or more in secondary forest.

(a) Field rat (*R.r. argentiventer*, 54) in grassland; in colonies in ears, also in colonies and scattered on edges and outside of ears, axillae and corresponding fold of hind leg; generally scattered with heavy infestations; often mixed with *deliensis*.

(b) Quail (and similar ground birds), in colonies and scattered under wings at wing-bend, axillae, folds of hindlegs, around anus, eyes, above beak, around neck, down sternum and midline of abdomen, on legs near foot. See also p. 89.

(a) Field rat (*R.r. argentiventer*, 19), or rats taking its place in grassy waste-land; also wood-rat (*R.r. jalorensis*) in plantations and forest-fringe; as for *akamushi*. See also p. 89.

(b) Quail etc. as for *akamushi*. Giant-rats, and *R.r. jalorensis* and *Crocidura*, in forest. In small numbers mixed with other chiggers; may be grouped: *R. bowersi*, *R. sabanus*, and *R. mulleri*, inside ears; *R. sabanus*, and *R. ratus*, in ears. Easily detached only from inside ears, but this is difficult with those attached elsewhere, where the larvae also do not appear to engorge satisfactorily, appearing shrivelled (but still alive).

Giant-rats (*R. mulleri*, *R. bowersi*, 10-15) in forest; in colonies inside ears and on anal region, also scattered on edges of ears; mixed with other species, confused with *deliensis*.

Ground-squirrels (*Rhinosciurus* and *Lariscus*) and Giant-rats in forest. In small or moderate numbers, scattered, inside ears only, mixed with other chiggers.

Giant-rats especially *R. sabanus*, and also *R. mulleri* in forest, in moderate or small numbers, ?local (Ulu Langat, F.R.), firmly attached, in small groups of 2-10, inside and outside ears, mixed with others.

Trombicula, subgenus *incertae sedis*, leveri-group of Audy 1953

16. *leveri* Womersley, 1952 EL 750 × 510, ovoid; colour unknown
17. *revelae* Audy, 1952 340 × 300, broad oval; pink

Trombicula, subgenus *incertae sedis*

18. *taphozous* Womersley, 1952 Large, 650 × 450, oval; pale orange or pink.
19. *consueta* Womersley, 1952 (N) 470 × 450, subglobular; light yellow to yellow

Eutrombicula, subgenus Eutrombicula Ewing

20. *wichmanni* Oudemans, 1905 (NA) Large, 600 × 410, oval to subpyriform; orange to light brown; ULs extremely active and fast, ELs very sluggish, easily detached.
Common Giant Black-Scorpion (*Heterometrus*) in forest, closely but not in contact with each other, under sternites and pecten. Only once found mixed with the not-commun large trombicule *Audya thompsoni* (q.v.)

(a) Skinks (esp. *Mabuya*), in moderate numbers, scattered under scales on legs in axillae, and along flanks, often 2 chiggers under one scale, mixed with *T. rara* and *B. gamifera* under neighbouring scales. Rarely, under scales on flanks, belly, head, anus of snakes.

(b) Domestic fowl, large numbers with *N. gallinarium*, in colonies on bottom of small punched-out ulcers with rolled-over edges, especially around upper leg and beneath tail.

(c) occasionally on rats outside forest, especially *R. t. jalorenensis*, in ears.

Eutrombicula, subgenus Eteronella Audy, 1956 (this Journal, p. 32)

21. *eltoni* Audy, 1956 (N) = *frittsi*; Won. 1952 Very small, 230 × 180, subovate; pallid; inactive; easily detached.
Common Flying lizards (*Draco* spp.), lightly attached, scattered, ventral surfaces of "wings" (collected twice; once with *Neo. riversi*).

Small, 300 × 200, elongate; orange to bright orange; actively crawling when disturbed.

Eutrombicula, subgenus *incertae sedis*, fieldi-group of Audy, 1956 (this Journal, p. 38)

21. *fieldi* Audy, 1956 370 × 250, elongate oval; light orange to orange; indistinguishable from *Bab. perniciosa*.

Siseea Audy, 1956 (this Journal, p. 41)

24. *rara* Walch, 1923 (N) Small, 300×250 , subovate; bright orange to red; active.

25. *subrara* Audy, 1956 (N) Small, 320×240 , broad oval; light yellow to yellow; sluggish.

Blankaartia Oudemans (= *Trigardhula* Bert)

26. *acuseutellaris* Walch, 1922 (NA) Large, UL 260×195 , PEL 600×420 subovate, wider posteriorly than *T. wickhami*; bright scarlet (the brightest coloured chigger encountered in Malaya); ELs clumsy.

Henslipia Ewing

27. *gateri* Womersley & Henslip, 1943 (N) Large, 690×395 subglobular.

Babiaugia Southcott, *sensu lato*

28. *parmifera* Womersley 1952 (N) 330×240 , subovate; light orange to orange; fairly active.

29. *holliati* Audy, 1956 460×350 , subovate; light orange.

Fonsecia Radford

30. *celesteae* Audy, 1956 Large, 660×460 , broad, oval; yellow.

Schöngastia Oudemans, *sensu stricto*

31. *victa* Gater, 1932 (N) UL 230×220 , EL 490×350 , subovate; light orange to orange; active.

Skinks (*Mabuya*) in forest, lightly attached under scales on flanks, joints of legs, on venter, small numbers, mixed with *T. wickhami* and *Bab. parmifera*, under neighbouring scales. Occasionally in ears of squirrels, rats, tree-shrews.

Giant pill-millipedes (*Sphaeropoeus*, 10) in forest (local (Bk. Lanjan F.R.)), colonies on the membrane flanking the anus, and scattered on intersegmental membranes, laterally, between sternites. Fairly common: over 1,500 specimens on 57 out of 212 millipedes.

Skinks (*Mabuya*) in forest, lightly attached under scales on flanks, joints of legs, on venter, small numbers, mixed with *T. wickhami* and *Bab. parmifera*, under neighbouring scales. Occasionally in ears of squirrels, rats, tree-shrews.

Field-rats (*R. r. argentiventer*) in ricefields (local); moderate to larger numbers, firmly attached in colonies inside and outside ears, usually accompanied by *T. delensis* which may surround a colony of it. Related to swampy or flooded land, probably primarily on water-birds.

Field-rat (*R. r. argentiventer*) from a rice-field area. Experiences in Africa by Veracammus-Grandjean suggest that this species is likely to pertain to water-birds, as with *Bl. acuseutellaris*.

Skinks (*Mabuya*) from forest; lightly attached in small groups or scattered, under scales on flanks, venter, legs; engorged larvae may protrude slightly from under the scale; mixed with *T. wickhami* and *T. rara* but never under same scale.

Skink (*Mabuya*) from forest; found once, scattered, lightly attached under scales of venter with *Bab. parmifera*, *T. wickhami*, *T. rara*.

Snake (*Natrix* sp), collected only on one occasion, under scales along flanks. Also once on skin *Mabuya*.

Giant-rat (*R. mulleri*) *R. r. kafurensis* in forest and forest fringe; "local (Sungei Buloh), in colonies and scattered, fairly small numbers and occasional, in ears.

<i>Euschongastia</i> Ewing, subgenus <i>Helenicula</i> Audy		Civet-cats ('musangs') and rats near forest fringe, in small colonies and scattered, inside ears; mixed with other species; not uncommon.	
32. <i>mutabilis</i> Gater, 1932 (N)	EL 390-510 \times 230-340, elongate oval, with a slight constriction; orange to bright orange; active and easily disturbed.	light orange to orange; fairly active.	Dominant chigger on arboreal (mammals) in forest (10-40), especially on squirrel <i>C. nigrovittatus</i> ; in colonies in ears, often alone, may be mixed with e.g. <i>T. spicata</i> , <i>E. oudeamaasi</i> .
33. <i>audyi</i> Womersley, 1952 (NA)	Small, EL 3— \times 200, subovate; light yellow.	Tree-rat (<i>Rattus canus</i>) from forest; as for <i>Asco malayensis</i> (q.v.).	
34. "CAN" (N)	Small, 320 \times 240, subovate; pallid to light yellow.	Treesquirrel (<i>C. temnus</i>) in forest; in small colonies in ears, mixed with <i>T. spicata</i> .	
35. "CTEN"	Small, 300 \times 220, subovate; light orange.	<i>Cracida</i> and water-shrew from forest; uncommon; scattered and occasional mixed with other species, in ears; rarely, on arboreal rat <i>R. eremicaventer</i> .	
36. <i>debilis</i> Gater, 1952	340 \times 260, elongate oval; pallid.	Common on House-rats (<i>R. r. diardii</i> , 10-20) and wood-rat <i>R. r. jadorensis</i> in oil palm plantation (30-40), in colonies in ears. A dominant, and usually the sole, chigger on house-rats in towns and villages over southeast Asia.	
37. <i>indica</i> Hirst, 1915 (NA)	Small, EL 300 \times 180, elongate oval; pallid to light yellow (form from forest-edge light orange to orange).	Intranasal in tree-rat <i>R. crenoventer</i> (3-4), in forest; possibly host-specific. See p. 90.	
38. "LAU" (N)	320 \times 230, subovate; light orange to dark orange.	Intranasal in spiny-rat <i>R. rajah</i> (1-5) in forest, scattered and in groups; mixed with <i>TBB</i> and <i>Dolomys</i> spp. See p. 90.	
39. "TAA" (N)	Large, EL 1,100 \times 690, broad oval, slight constriction; pallid to light orange.	Intranasal in <i>R. rajah</i> (30) in forest, as with TAA, with which it usually occurs. See p. 90.	
40. "TBB" (N)	Fairly large 690 \times 500, broad oval, slight constriction; pallid to creamy.		
<i>Euschongastia</i> , subgenus <i>Walchiella</i> Fuller (this may warrant generic rank)		Common (10-30) on ground-living rodents in forest, especially giant-rats (<i>R. mulleri</i> , 25; <i>bowersi</i> , 19); also tree-rat <i>R. canus</i> (1); lightly attached, in colonies and scattered, inside and outside ears, to lips and chin, and around anus.	
41. <i>oudemansi</i> Walch, 1922 (N)	Small, 250 \times 170 broad oval to subglobular; smooth surface; pallid to orange (1); active and easily detached.	Treemouse <i>Chiropodomys</i> , found on only 3 out of 62 examined, inside ears.	
42. "FAT" (N)	Small, 230 \times 185, broad oval to subglobular; pallid to light yellow.	Gymnure <i>Hydromys</i> in forest; attached in colonies and scattered inside and outside ears, folds of fore and hind legs, and around anus (described from Borneo).	
43. <i>asomoluca</i> Traub & Audy, 1954 (N)	EL 400 \times 320, broad oval; pallid to light yellow.		
<i>traubi</i> Womersley, 1952	UL 195 \times 162, subglobular; as for <i>oudemansi</i>	Giant-rat, (<i>R. satanana</i>), once; ?in ears	

Euschöngastia, subgenus *incertae sedis*, lacunosa-group of Audy, 1953 (?= *Widhillella*)

45. lacunosa Gater, 1932 (N) Large, 500-700 \times 300-460, elongate oval with slight constriction; pallid to light yellow; colonies easily distinguished by size and grape-bunch-like appearance. Indistinguishable from *E. lacunosa*

46. nadchatrami Womersley, 1952 (N) Large, 500-700 \times 300-460, elongate oval with slight constriction; pallid to light yellow; colonies easily distinguished by size and grape-bunch-like appearance. Giant-rat (*R. sabanus*) in forest; small numbers but not uncommon, scattered, inside and outside ears near edge; usually mixed with *E. lacunosa*.

Euschöngastia, *incertae sedis*

47. lipoxena Womersley, 1952 (N) Large, UL 300 \times 250, EL 1,200 \times 1,000, both UL & EL subglobular; pallid to creamy; appearance of EL more tick-like than chigger-like; sluggish. EL 600 \times 390, elongate oval; light yellow; the long whip-like DS may be visible under a lens, otherwise almost indistinguishable from *E. lacunosa*. 320 \times 250, broad oval; pallid. Medium 420 \times 280, subpyriform; pallid.

48. "THOM" (N) EL 600 \times 390, elongate oval; light yellow; the long whip-like DS may be visible under a lens, otherwise almost indistinguishable from *E. lacunosa*. 320 \times 250, broad oval; pallid.

49. "BIS" (N) 320 \times 250, broad oval; pallid.

50. "SELL" (N) Medium 420 \times 280, subpyriform; pallid.

Ascoschöngastia Ewing, *sensu stricto* (No. 51) & *Pseudoschöngastia* Lipovský (No. 52)

51. malayensis Gater 1932, (N) Small, UL 180 \times 130, EL 390 \times 250, subovate, to subglobular slight constriction; pallid to slightly greenish yellow; sluggish, clumsy habit, reluctant to leave host.

52. "NOV" Small, PEL 280 \times 230, broad oval; light yellow.

Neoschöngastia Ewing

53. gallinarum Hatori, 1920, (N) 390 \times 320, subovate; pale orange to orange; active, wandering freely when disturbed.

54. riversi Wharton & Hardcastle, 1946 350 \times 200, elongate oval; yellow.

New Genus in MS = *Dolotisza* VN-group of Audy 1953

species: Large, 640×500 , broad oval, slight constriction; pallid to pale yellow.

55. "VERC" (N)

56. "BRA" (N)

57. "VARM" (N)

58. "DOM" (N)

59. "OWE" and others

Sebastodeschia Jadin & Vercammen-Grandjean, 1954, *virus lato*
 60. *vercammeni* Audy, 1956
PEL 390×260 , oval; pallid; single specimen.

Note in press: Ten species are being described in *Malaysian Parasites XVI-XXI*, 1957.

Giant-rat (*R. sabarua*) in forest; ?inside ear; a fully engorged specimen might be difficult to distinguish from *lacunosa*-group.

Intranasal, especially in spiny rat *R. rajah* in forest (30) scattered and in groups deep in nasal cavities; commonest group of intranasal chiggers; occasionally found externally (e.g. in giant-rats from higher altitudes; *D. manipurensis* is from a rat's ears in India); mixed with species of *Laurentella* (q.v.). See p.

Subfamily GAHRLEPINÆ

Gahrlepia Oudemans, subgenus *Gahrlepia* (including *Gateria* Ewing), after Traub & Morrow, 1955

61. *cetrata* Gater, 1932 (N)
PEL $400 \times 490 \times 279 \times 330$, broad oval; pallid; sluggish,

380 \times 260, oval; described from a single Giant-rat (*R. milleri*) from forest specimen, not encountered again since.

decora-group:

63. *decora* Womersley, 1952
 64. *insigne* Womersley, 1952
PEL $340-420 \times 180-350$, oval to broad oval; pallid; DS prominent, visible with hand lens; sluggish, the honeycombed scutum is easily visible under a low-power stereoscopic microscope.

65. *ornata* Womersley, 1952 (N)

66. *picta* Traub & Morrow, 1952

67. *tessellata* Traub & Morrow, 1952

Various ground-living hosts in forest (Giant-rats; *Tupaias* *glis*; *Cricetidae*; *Hydromys*); not common, scattered; fairly lightly attached to edges of ears and lower jaw and outside ears; on the insectivores, to edges of ears, and abdomen; mixed with other chiggers.

1. 320-460×260-330, broad oval; pallid to creamy; sluggish (those attached to edges of ears appear desiccated).
 68. *fletcheri* Traub & Morrow, 1955
 Gater 1932, (N)
 70. *rutila* Gater, 1932 (N)
Gahliepia, subgenus *Schingastilla* Hirst, after Traub & Evans, 1953
 71. *aronia* Traub & Evans, 1953 (N)
 72. *birella* Traub & Evans, 1953
 73. *hipposideros* Audey, 1952
 74. nr. *helata* Traub & Morrow, 1954
Gahliepia, subgenus *Walchia* Ewing, after Womersley 1952
 75. *brennani* Womersley 1952 (N)
 76. b. var. *ventralis* Womersley 1953 (N)
 77. *disparnguis* Oudemans 1929, (N)
 78. *enode* Gater 1932 (N)
 79. *leuthwaitei* Gater 1932, (N)
 80. *pingue* Gater 1932, (N)

320-460×260-330, broad oval; pallid to creamy; sluggish (those attached to edges of ears appear desiccated).
 On giant-rat (*R. sabanus*) and Tree-shrew (*Tupaia glis*) (6) in forest; fairly lightly attached, in groups and scattered, all along edges of ears and on ears and outside ears; on *Tupaia*, along edges of ears, and with other abdominal; mixed with other chiggers on ears, and with other Gahliepines on ear-edges and especially under jaw (chin). This and *G. (W.) pingue* are the commonest Gahliepines in Malaya.
 In fairly large numbers in colonies on chins, also among vibrissae on *R. rattus* spp. on Sembilan Islands and Jarak Islands.
 Giant rat in forest, is not common; as for *G. fletcheri*.
 As for *G. fletcheri*.
 320-360×210-260, oval or slightly pyriform; pallid; sluggish.
 Small 360×300, broad oval; pallid to creamy; shiny surface.
 330×250, broad oval; pallid; sluggish.
 315×125, subovate; pallid.
 PEL 230×180, subovate; pallid to light yellow.
 EL 330×250, broad oval; pallid to creamy.
 EL 640×370 elongate, oval, marked constriction; pallid to light yellow.
 380×350 elongate oval, slight constriction; light yellow.
 Indistinguishable from *pingue* (q.v.).
 Small 320-460×240-330, elongate oval, with constriction; pallid.
 480×330, elongate oval; with constriction; pallid.
 Giant-rat (*R. sabanus*) in forest, fairly common (1-3), in groups in ears, with other chiggers.
R. exulans and *R. whiteheadi* in open secondary growth, occasionally in large numbers (1-6), rare in forest; often unmixed with other spp. on *R. whiteheadi*; as for *pingue*.
 Spiny rat (*R. rajah*) and Giant-rat (*R. sabanus*) in forest, fairly common (1-3), in groups in ears, with other chiggers.

81. *rustica* Gater 1932, (N) 350-410×220-260, oval not constricted; pallid to creamy.

82. *turmalis* Gater 1932, (N) Indistinguishable from *rustica*.

83. nr. *rioi* Gunther, 1940 350×390, broad oval, slight constriction; light yellow.

Subfamily LEEUWENHOEKINAE

Whartonina Ewing, after Wharton & Fuller, 1952

84. "PEN" Womersley in MS

85. sp. 'B'

Large, 540×400, broad oval, orange to orange-red; inactive; mouthparts deeply buried and body perpendicular.

Large UL 280×230, EL 920×730; as above.

Species (TROMBIDIIDS) which may be confused with subfamily APOLONIINAE

Cockingsia Womersley: according to Southcott (personal communication), this is probably a larval *Neotrombidium*.

86. *tenuipes* Womersley 1953 Large, UL 260×160, EL 720×480 sub-ovate; light orange.

Audyania Womersley: Family Trombidiidae, subfamily Trombellini

87. *thompsoni* Womersley 1953 (N) Large, 650×450, broad white; sluggish.

On fruit bat (*Cynopterus (Penhetor)*) (33 on 9 bats) from forest, one collection; scattered, very firmly attached to dorsal and ventral surfaces of wing-membranes; unaccompanied by other chiggers.

A giant longicorn beetle from forest; a few hundred collected from near bases of wings on ventral surface; in groups and scattered.

Common Giant Black Scorpion (*Heterometrus longimanus*) from forest, in moderate numbers, lightly attached in groups and scattered mostly under peets, also on intersegmental membrane

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